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New records of poaceous rusts from PakistanA. ISHAQ¹, N.S. AFSHAN^{2*} & A.N. KHALID¹¹Department of Botany & ²Centre for Undergraduate Studies,
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ABSTRACT — *Puccinia stipae* var. *stipae* and *Uromyces sporobolicola* are described and illustrated as new records for Pakistan. *Calamagrostis pseudophragmites* for *Puccinia sessilis*, *Agrostis gigantea* for *P. recondita*, and *Dactylis glomerata* for *P. striiformis* are new poaceous hosts for these rust fungi from Pakistan.

KEY WORDS — graminicolous, Uredinales, weeds

Introduction

Poaceous weeds are an important competitor of all crop plants worldwide as well as in Pakistan. Economically important grass species are threatened by invasive weeds, and several host-specific rust fungi have been used as biological control agents against certain noxious weeds (Yandoc-Ables et al. 2006). There are about 158 genera (492 species) of plants from the family *Poaceae* in Pakistan. Among the 100 rust species known to infect 130 plant species (Afshan et al. 2010) are 70 species of *Puccinia* Pers. and 14 species of *Uromyces* (Link) Unger (Afshan & Khalid 2009; Afshan et al. 2009, 2010a,b, 2011; Iqbal et al. 2009; Khalid & Afshan 2009).

In this paper we report *Puccinia stipae* var. *stipae* on *Stipa* sp. and *Uromyces sporobolicola* on *Sporobolus marginatus* as new records and identify new poaceous hosts for *Puccinia sessilis* (*Calamagrostis pseudophragmite*), *P. recondita* (*Agrostis gigantea*), and *P. striiformis* (*Dactylis glomerata*) in Pakistan.

Materials & methods

Infected plants with their inflorescences were collected from sampling sites throughout Pakistan. The rusted specimens were photographed and free hand sections and scrape mounts of infected portions were observed under the stereomicroscope. Twenty spores of each spore state found were examined under microscope (Nikon YS 100), and spore dimensions were determined using a Zeiss eyepiece screw micrometer.

Sections and spores were photographed by digiporo-Labomed and illustrated using a Leitz camera lucida (Wetzlar Germany).

Enumeration of taxa

Uromyces sporobolicola J.C. Lindq., Revta Fac. Agron. Vet. Univ. nac. La Plata, Ser. 3, 38: 89 (1963 ["1962"]).

FIG. 1

SPERMOGONIA and AECIA not found. UREDINIA adaxial, cinnamon-brown; UREDINIOSPORES light brown to hyaline, echinulate, globose to subglobose, $(19.5-25-33 \times (22-2)2-38 \mu\text{m})$; wall $1.6-2.6 \mu\text{m}$ thick, germ pores 2-4, supraequatorial. TELIA amphigenous, blackish, covered by the epidermis; TELIOSPORES 1-celled, brown, ovate, $19-21.5 \times 21.5-27 \mu\text{m}$; apex $2.4-5.4 \mu\text{m}$ thick, wall $1.4-2 \mu\text{m}$ thick; pedicel short, $\leq 11 \mu\text{m}$ long.

MATERIAL EXAMINED: PAKISTAN, PUNJAB, Sialkot, at 234 m a.s.l., on leaves of *Sporobolus marginatus* Hochst. ex A. Rich., stages II + III, 20 April 2011, AIM # 27 (LAH Herbarium No.1130).

COMMENTS: Cummins (1971) reported *U. sporobolicola*, here a new record for Pakistan, on *Sporobolus pyramidatus*. Other rusts known to infect *Sporobolus*

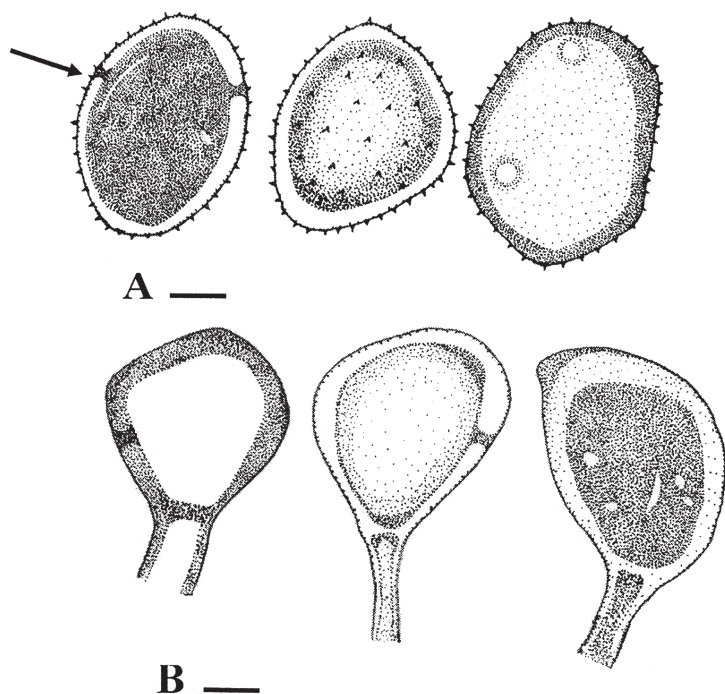


FIG. 1: *Uromyces sporobolicola* (lucida drawing; scale = $10 \mu\text{m}$).

A. Urediniospores showing germ pores (arrowed); B. One-celled teliospores.

species (*S. arabicus*, *S. coromandelianus*) in Pakistan include *Puccinia sporoboli-arabici* Afshan et al., *P. sporoboli-coromandeliani* Afshan et al., *Uromyces ignobilis* (Syd. & P. Syd.) Arthur and *U. tenuicutis* McAlpine from Lahore (Ahmad 1956a,b, 1976, Masood et al. 1995) and NWFP (Afshan et al. 2008, 2010a).

Puccinia stipae (Opiz) Arthur, Bull. Iowa Agric. Coll. Dept. Bot.: 160 (1884)
var. *stipae*

FIG. 2

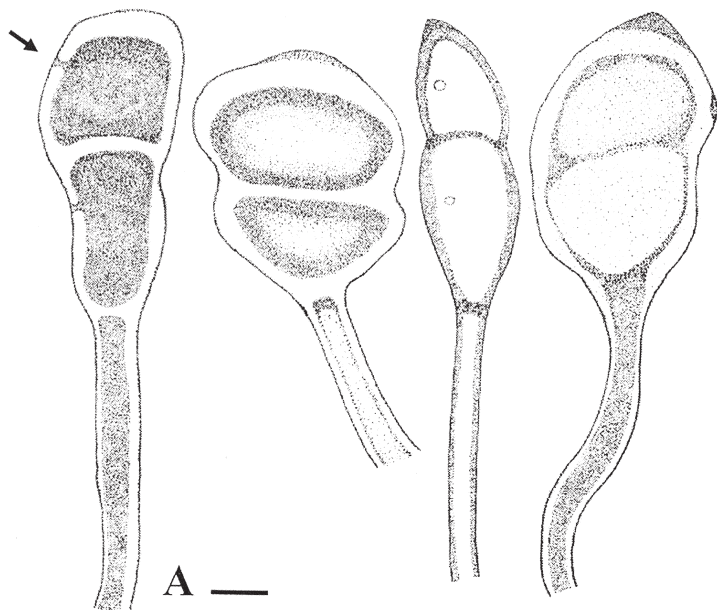
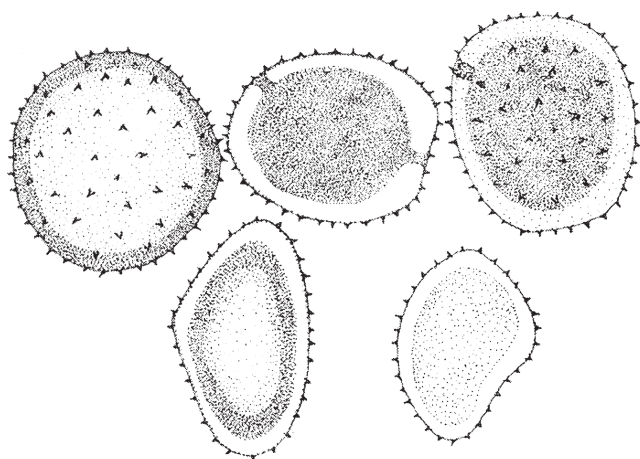


FIG. 2: *Puccinia stipae* var. *stipae* (lucida drawing; scale = 13 μ m).
Teliospores showing germ pores (arrows).

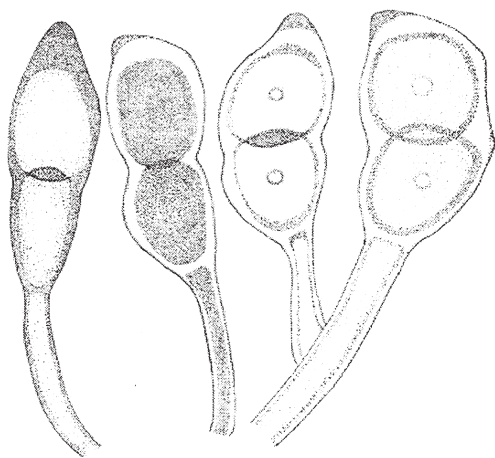
SPERMOGONIA, AECIA, & UREDINIA not found. TELIA blackish brown, adaxial, exposed, compact, 0.14–0.27 $\times$ 0.13–0.19 mm. TELIOSPORES golden brown, broadly ellipsoid, 23–34 $\times$ 45–63 μ m; wall 1.9–2.6 μ m thick at the sides, 4.5–8 μ m thick apically; pedicel long, broken mostly, hyaline, 5.5–9 μ m wide, $\leq$ 112 μ m long.

MATERIAL EXAMINED: PAKISTAN, GILGIT & BALTISTAN, Skardu, Shigar valley, at 3000 m a.s.l., on leaves of *Stipa* sp., stage III, 20 July 2010, AIM # 38 (LAH Herbarium No.1131).

COMMENTS: (Cummins (1971) previously reported *P. stipae* var. *stipae*, here a new record for Pakistan, on *Stipa spartea*. Ahmad (1969) reported a different variety, *Puccinia stipae* var. *stipina* (Tranzschel) H.C. Greene & Cummins (= *Puccinia stipina* Tranzschel), on *Stipa himalaica* from Quetta in Pakistan.



A —



B —

FIG. 3: *Puccinia sessilis* var. *sessilis* (lucida drawings; scale = 14 μ m).

A. Urediniospores showing echinulate surface ornamentation and germ pores; B. Teliospores.

Puccinia sessilis W.G. Schneid., Jahresber. Schles. Ges. Vaterl. Cult. 49: 19 (1871)
var. *sessilis*

FIG. 3

SPERMOGONIA and AECIA not found. UREDINIA on stipe, brown, naked. UREDINIOSPORE light brown to hyaline, globose to subglobose, 21–32 $\times$ 24–36 μ m; wall 1.9–2.4 μ m; germ pores up to 4, scattered or tending to be equatorial.

TELIA amphigenous, blackish, covered by epidermis. TELIOSPORE chest nut brown, $23\text{--}32 \times 47\text{--}68 \mu\text{m}$; wall $1.5\text{--}3 \mu\text{m}$ thick at sides, $6.5\text{--}13 \mu\text{m}$ thick apically, pedicel $\leq 77 \mu\text{m}$ long.

MATERIAL EXAMINED: PAKISTAN, GILGIT & BALTISTAN, Skardu, Shigar valley, at 3000 m a.s.l., on leaves of *Calamagrostis pseudophragmites* (Haller f.) Koeler, stages II + III, 21 July 2010, AIM # 39 (LAH Herbarium No.1132).

COMMENTS: Khalid & Iqbal (1996) previously reported *P. sessilis* on leaves of *Phalaris minor* from Deosai Plains near Pakora Lake. *Calamagrostis pseudophragmites* is a new host for the variety in Pakistan.

Puccinia striiformis Westend., Bull. Acad. Roy. Sci. Belgique 21: 235 (1854)

var. *striiformis*

FIG. 4

SPERMOGONIA and AECIA not found. UREDINIA light brown, adaxial, in linear series. UREDINIOSPORES globose to subglobose, hyaline, echinulate, $24\text{--}31 \times 27\text{--}36 \mu\text{m}$; Wall $1.4\text{--}2.8 \mu\text{m}$ thick, germ pores 2-many, scattered. PARAPHYSES

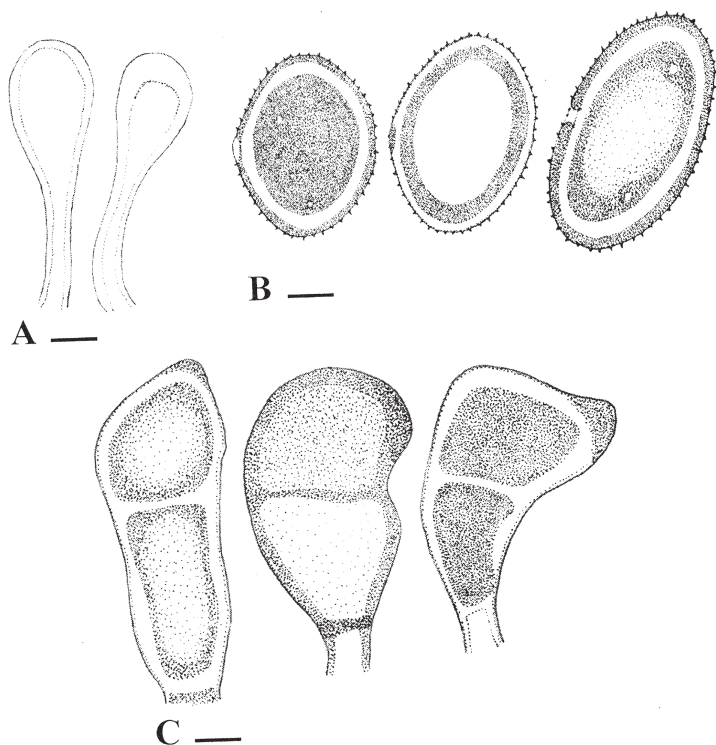


FIG. 4: *Puccinia striiformis* var. *striiformis* (lucida drawings; scale = $13 \mu\text{m}$).

A. Paraphyses; B. Urediniospores showing germ pores (arrowed); C. Teliospores.

capitate, having cap of 6.5–8.0 μm diameter. TELIA blackish, abaxial, sheaths in linear series, covered by epidermis, with hyaline paraphyses, forming locules. TELIOSPORES clavate, light brown, 2-celled, 13–19(–22.0) $\times$ 34.0–50.0 μm ; sometimes upper cell thicker than lower, apex 3.0–7.0(–9.0) μm thick, wall 1–2 μm thick, pedicel very delicate.

MATERIAL EXAMINED: PAKISTAN, GILGIT & BALTISTAN, Fairy Meadows, at 3036 m a.s.l., on *Dactylis glomerata* L., stages II + III, 12 August 2007, AIM # 20 (LAH Herbarium No.1133).

COMMENTS: Numerous authors have reported *P. striiformis* var. *striiformis* on *Triticum aestivum*, *Hordeum vulgare*, and *Poa* sp. from Quetta, Kalat, Tandojam, Rawalpindi, Nathia Gali, Shogran (Kaghan valley), and Lahore (Ahmad 1956a,b, Khan & Kamal 1968, Malik et al. 1968, Malik & Virk 1968, Kakishima et al. 1993) and on *Leersia oryzoides* from Fairy Meadows (Afshan 2009). *Dactylis glomerata* is a new host for the variety in Pakistan.

Puccinia recondita Desm., Bull. Soc. bot. Fr. 4: 798 (1857)

FIG. 5

SPERMOGONIA and AECIA not found. UREDINIA abaxial, brown. UREDINIOSPORES globose to subglobose, hyaline, 15–21 $\times$ 17–26 μm ; walls 1.4–2.6 μm thick, echinulate; germ pores 2–many, scattered. TELIA abaxial, black, covered by epidermis, 0.1–0.2 $\times$ 0.04–0.05 mm. TELIOSPORES light

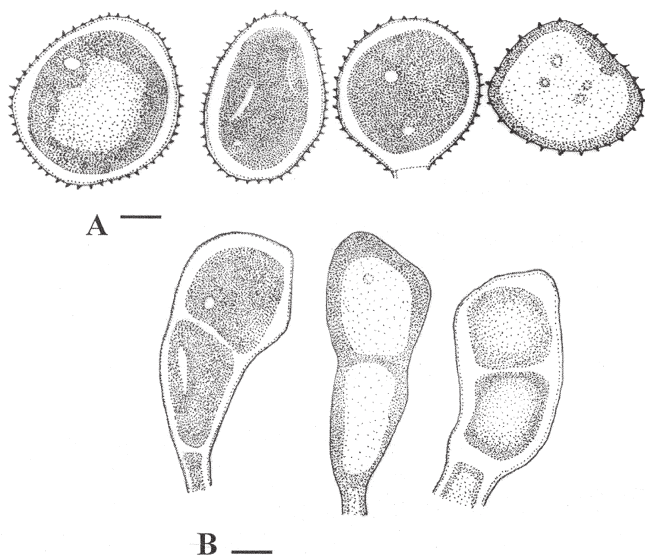


FIG. 5: *Puccinia recondita* (lucida drawings; scale = 13 μm).

A. Urediniospores showing germ pores; B. Teliospores.

brown to hyaline, clavate, 2-celled, $13-19(-21) \times 38-52 \mu\text{m}$; wall $1.6-2.4 \mu\text{m}$ thick, apex $3-6 \mu\text{m}$ thick; pedicel very delicate.

MATERIAL EXAMINED: PAKISTAN, KHYBER-PAKHTUNKHAWAH (KPK), Sharan, at 2752 m a.s.l., on *Agrostis gigantea* Roth, stages II + III, 27 July 2007, AIM # 19 (LAH Herbarium No.1134).

COMMENTS: *Agrostis gigantea* is a new host from Pakistan for *Puccinia recondita*, which has previously been reported on *Agropyron* sp., *Aquilegia fragrans*, *A. pubiflora*, *Brachypodium* sp., *Eremopyrum bonaepartis*, *Lolium perenne*, *Triticum aestivum*, and *Thalictrum minus* from Swat, Kaghan valley, Ayubia, Tandojam, Shogran to Sari, Sharan, Murree, Faisalabad, and Quetta (Ahmad 1956a, Hasnain et al. 1959, Jørstad & Iqbal 1967, Ghaffar & Kafi 1968, Khan & Kamal 1968, Malik & Virk 1968, Malik et al. 1968, Ahmad & Arshad 1972, Ono 1992, Ono & Kakishima 1992).

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